

Medicinal plants affected contractility of smooth muscles- A review

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Abstract: Many studies showed that medicinal plants possessed stimulatory and inhibitory effects on the contractility of smooth muscles. These effects are mediated by many mechanisms included interference with neurotransmitters, neuro-mediators, second messengers, ionic channels and other mechanisms. The current review will highlight the medicinal plants affected contractility of vascular, gastrointestinal, reproductive, respiratory, urinary and other smooth muscles.

Keywords: medicinal plants, pharmacology, therapeutic, contractility, contraction, relaxation

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I. INTRODUCTION:

In recent years, ethno medicinal studies has received much attention as this brings to light the numerous little known and unknown medicinal virtues especially of plant origin which needs evaluation on modern scientific lines such as phytochemical analysis, pharmacological screening and clinical trials. Plants are a valuable source of a wide range of secondary metabolites, which are used as pharmaceuticals, agrochemicals, flavours, fragrances, colours, biopesticides and food additives. Medicinal plant possessed wide brange of pharmacological and therapeutic effects included, antidiabetic[1-3], anti-inflammatory[4-5], anticancer [6-9], antimicrobial [10-14], dermatological [15-18], detoxification [19], reproductive [20-25], respiratory [26-27], gastrointestinal [28-30], antiparasitic, antiprotozoal and molluscicidal [31-33], analgesic and antipyretic [5, 34], antiurolithiatic and diuretic effects [35-36], hypolipidemic, hemostatic, fibrinolytic, anticoagulant and cardiovascular [37-40], central nervous [41-42], immunological [43-44], antioxidant and free radical scavenging [45-46], smooth muscle [47], and mammary gland stimulating effects [48-50]. This review was designed to highlight the stimulatory and inhibitory effects of medicinal plants on smooth muscle contractility.

Table 1: Medicinal plants affected contractility of smooth muscles

Medicinal plant	Extract or compounds	model	Action	Ref
<i>Allium cepa</i>	Five alk(en)yl sulfinothioic acid alk(en)yl-esters isolated from onion	Human poly morphonuclear leucocytes and bronchial tissue of guinea-pigs	Five alk(en)ylsulfinothioic acid alk(en)yl-esters isolated from onions inhibited 5-lipoxygenase of porcine leucocytes, histamine release and leukotriene B4 and C4 biosynthesis of human polymorphonuclear leucocytes, thromboxane B2 biosynthesis by human platelets and allergen- and PAF-induced bronchial obstruction of guinea-pigs. Accordingly the anti-asthmatic and anti-inflammatory effects of onions depend in part on the thiosulfinate moiety.	51
	Isothiocyanate compounds isolated from onion	The other hand, the effect of onion extracts on bronchial obstruction induced by inhalation of ovalbumin in guinea-pigs	Benzyl-isothiocyanate (BITC) inhibited BO in a dose-dependent fashion: 150 mg/kg: 89%; 75 mg/kg: 76%; 30 mg/kg: 66%; 15 mg/kg: 49%. Ethyl-isothiocyanate and allyl-isothiocyanate showed similar effects, while, p-hydroxy-benzyl-isothiocyanate, was ineffective.	51-52
	Extract obtained by maceration	Effects on cytokine and on smooth muscle	<i>Allium cepa</i> extract caused relaxation of tracheal rings, and a reduction in total number of cells in bronchoalveolar lavage	53

		contraction in vitro and its therapeutic potential in a murine model of asthma	and eosinophil peroxidase in lungs.	
<i>Allium sativum</i>	Aqueous bulb extract containing 0.06%-0.10% of allicin	Isolated smooth muscle of trachea of rats	It induced a dose-dependent relaxation with recorded EC ₅₀ values of 71.87 ± 5.90 µg/ml. Pretreatments with mepyramine (10 ⁻⁷ M), methysergide (10 ⁻⁷ M), caffeine (10 ⁻⁶ M), theophylline (10 ⁻⁶ M), nifedipine (10 ⁻⁶ M), and dipyridamole (10 ⁻⁶ M) did not alter <i>Allium sativum</i> bulb aqueous extract Concentration-response curves were significantly shifted toward right in the presence of aspirin (3.10 ⁻³ M), indomethacin (10 ⁻⁶ M), prazosin (10 ⁻⁶ M), and propranolol (10 ⁻⁷ M).	54
	application (4 g/ml)	rabbit-duodenum	An increase of the spontaneous contraction of rabbit-duodenum was established by garlic solution. Blockade the M ₃ muscarinic receptors of the smooth muscle by atropine sustained normal contraction	55
	Raw garlic, several extracts and polysulfides	Experimental and clinical studies	Garlic-derived polysulfides stimulate the production of the vascular gasotransmitter hydrogen sulfide (H ₂ S) and enhance the regulation of endothelial nitric oxide (NO), which induce smooth muscle cell relaxation, vasodilation, and BP reduction. Garlic induced significant reduction in systolic and diastolic blood pressure due to a direct relaxant effect on smooth muscles.	56-67
<i>Ammi visnaga</i>	visnadine	rat aortic ring and portal vein segment	It was selectively inhibited the contractile response in the rat isolated aortic ring and portal vein segment. It caused nonspecific inhibition of vascular smooth muscle.	68-71
	visnadine	in isolated guinea-pig hearts	Visnadin, 60.0 µg/ml or 120.0 µg/ml, increased coronary blood flow in isolated guinea-pig hearts by 46% and 57% respectively.	72
	boiled distilled water seeds extract	rabbit jejunum	It caused reduction of intestinal contraction. Neostigmine and pilocarpine effect was inhibited by the administration of <i>Ammi visnaga</i> .	73
	Khella raw fruit	Clinical	Khella's antispasmodic properties are also useful to treat asthma attacks. During the 1950's, research into khella's usefulness as an asthma treatment led to the creation of many asthma medications containing khellin and visnagin	74
	Khellin, visnagin or crude mixture of the <i>Ammi visnaga</i>	Clinical	Khellin, visnagin or crude mixture of the <i>Ammi visnaga</i> active principles have a direct muscle relaxant. Oral preparation is used to dilate the coronary arteries efficiently in angina pectoris	75
<i>Andrachne aspera</i>	alcoholic extract of the aerial parts	guinea-pig ileum and rat ileum	It showed spasmolytic activity and antihistaminic activity on guinea pig ileum	76-79
	alcoholic extract of the aerial parts	tracheal muscle of cat	It showed significant spasmolytic activity on tracheal muscle of cat.	76-79
<i>Anthemis nobelis</i>	chamomile was boiled and immediately used by inhalation for 5-10 minutes using vapor machine	Clinical	In an open clinical study carried out on 54 patients with chronic bronchial asthma, it showed antiasthmatic effects, it caused significant elevation in the values of forced expiratory volume in first second (FEV ₁ %) and forced volume capacity (FVC) with marked reduction in asthmatic attacks.	80-81

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	crude herbal extract	guinea pig ileum	The crude herbal extract induced an immediate, moderate, and transient contraction of guinea pig ileum via the activation of cholinergic neurons of the gut wall.	82
<i>Arundo donax</i>	a defatted ethanolic extract of the rhizomes	Rats	It produced hypotensive and antispasmodic effects against histamine, serotonin and acetylcholine induced spasms. Bufotenidine showed three main pharmacological actions, antiacetylcholine effect, histamine release and uterine stimulant effects.	83-84
	alkaloid gramine extracted from the plant	in dogs	It possessed vasopressor activity, raising the blood pressure in dogs after small doses and causing a fall in larger doses.	85-89
<i>Asparagus officinalis</i>	aqueous extract	smooth muscle of rabbit jejunum	It caused relaxation of spontaneous contractions of isolated smooth muscle of rabbit jejunum.	90-91
<i>Bacopa monnieri</i>	ethanol extract	guinea-pig trachea in calcium free high K^+ -MOPS-PSS	The plant extract (500 and 700 $\mu\text{g/ml}$) significantly ($P < 0.05$) depressed and shifted the calcium concentration-response curves (1×10^{-3} - 1×10^{-1} M) to rightward similar to that of nifedipine.	92
	methanolic fraction	mast cell stabilization	It exhibited potent activity comparable to disodium cromoglycate, a known mast cell stabiliser.	93-94
	ethanol extract	intestinal smooth muscles of rabbit and guinea-pig	It inhibited the spontaneous movements of both guinea-pig ileum ($\text{IC}_{50} = 24 \pm 4$ microg/ml) and rabbit jejunum ($\text{IC}_{50} = 136 \pm 9$ microg/ml). It (260 microg/ ml) caused marked reduction in acetylcholine- and histamine-induced responses (0.0001-10 microM) in the ileum.	95
<i>Calotropis procera</i>	ethanol, n-butanol, and ethyl acetate extracts	duodenum and ileum smooth muscles in rats	They induced stimulatory effect which abolished by atropine sulfate, indicated that the stimulatory effect on smooth muscle was mediated by cholinergic effect.	96-98
	dry latex	smooth muscles of gastro-intestinal tract in rats and rabbits	50-1000 mg/kg of dry latex produced a dose-dependent decrease in intestinal transit along with a decrease in intestinal content. At lower doses dry latex produced dose-dependent gastrointestinal smooth muscles in vitro (rabbit ileum and fundus of rat stomach) that was followed by desensitization at higher doses.	99
	latex alone and in the presence of loperamide and atropine	on intestinal transit in rats using charcoal meal test	Latex of <i>Calotropis procera</i> inhibited intestinal motility and its action was potentiated by atropine and loperamide	100
	aqueous extract	trachea smooth muscle chain of Guinea-pig	50, 100 and 200 $\mu\text{g/ml}$ of the extract showed a dose-dependent direct relaxant activity.	101
<i>Capparis spinosa</i>	aqueous extract	aortic rings of rats	Adding of <i>Capparis spinosa</i> aqueous extract (CSAE) during the plateau phase of contraction, induced by noradrenaline and KCl, produced a rapid relaxation. Incubation of aortic ring with CSAE during 30 min shifted the noradrenaline induced dose response curve ($p < 0.001$), the maximum response ($p < 0.001$) was attenuated which indicating that antagonistic effect of the α_1 -adrenoreceptors was non-competitive.	102-103
	aqueous extract of different parts (roots, leaves, stems, flowers,	thoracic aorta rings and windpipe of rat	Addition of extracts during the stage of contraction led by the phenylephrin for the thoracic arteries showed a light vasodilatation. Incubation (30 min) with	104

	fruits and kernels)		extracts showed a significant vasodilator effect for fruits and kernels, and vasoconstrictor effect for leaves.	
<i>Capsella bursa-pastoris</i>	Several extracts	small intestine in the guinea-pig	The plant induced stimulatory action unaffected by atropine and diphenhydramine, but were inhibited by papaverine.	105-106
	extract of dried or green plant	the small intestines and uterus of guinea pigs	The extract of dried or green plant causes strong contraction of the small intestines and uterus of guinea pigs. A quarternary ammonium salt has been isolated from the herb which is reported to be responsible for its pharmacological activity.	107
	A purified substance from an alcohol extract	rat uterus	It exerted contractile activity on the rat uterus which was similar to that of oxytocin. The effective substance had some characteristics of a polypeptide.	108
	aqueous extract	isolated rabbit and guinea pig uterine horn	Water extracts (infusions) from a group of medicinal plants including <i>Capsella bursa-pastoris</i> enhanced the uterine tonus in isolated rabbit and guinea pig uterine horn.	109
	tea-like infusion	clinical	The plant was used in the treatment of menorrhagia and metrorrhagia, which seem to be mediated through an increased contraction of smooth muscles and uteromimetic effect. As a tea-like infusion, the recommended dose is 2 g to 4 g in 150 ml of water after boiling for 15 minutes.	110
<i>Carum carvi</i>	aqueous extract (AE), macerated extract (ME) and essential oil (EO)	isolated tracheal chains of guinea pigs	The bronchodilatory effects were studied by examining the relaxant effects on precontracted by 10 μ M methacholine (M) of the isolated tracheal chains of guinea pigs. The bronchodilatory effect of AE, ME, and EO was lower than that of theophylline ($p < 0.001$), but it was significantly higher than the effect of saline ($p < 0.05$ for AE, $p < 0.01$ for ME, and $p < 0.005$ for EO). The bronchodilatory effect was mainly due to the non-competitive antagonistic property at muscarinic receptors. The β - stimulatory effect and/or anti-histaminic effect of EO might be contributed to its non-competitive property.	111-112
<i>Cassia occidentalis</i>	aqueous extract of the leaf	rat aortic rings	The extract inhibited contraction elicited by noradrenaline (NA) and potassium chloride (KCl). It also relaxed aortic rings precontracted with 10^{-7} M NA and 50m M KCl. The relaxation did not require the presence of an intact vascular endothelium and was not affected by indomethacin and methylene blue.	113
	soaking seeds extract	In vivo and in vitro, intestinal and lung parenchymal strips of chickens	The maximal contractile responses of the treated birds decreased significantly compared to those of the control group. The decrease was also directly related to the length of treatment. The day 5 group showed the maximum decrease. The <i>in vitro</i> study suggested involvement of smooth muscles as a primary site for the toxicosis caused by <i>Cassia occidentalis</i> . The decrease in maximal response of lung parenchymal strip suggested the existence of an active principle(s) in the extract which caused the effect by systemic absorption.	114-115
<i>Casuarina equisetifolia</i>	bark extract	isolated ileum	The bark extract reduced contractions in isolated ileum induced by spasmogens like	116-117

			ACh, Histamine, KCl and BaCl and potentiated the effect of Nifedipine suggesting an antimuscarinic, antihistaminic and a calcium channel blocking action.	
	of methanolic extracts of wood, bark, fruit and leaf	Tracheal chain	The extracts of wood and bark inhibited the histamine induced contraction of trachea (10-80 mcg/ml) in dose dependent pattern (P<0.05) while leaf and fruit extracts were without any effects. The successive chloroform extract demonstrated more activity (63.30 ± 10.33) as compare to petroleum ether (87.5 ± 13.24) and methanolic extract (166.66 ± 23.32) of wood (P<0.05). The chronic treatment of methanolic wood extract (100 mg/kg, ip) significantly reduced the clonidine induced catalepsy at 60 and 120 minutes (P<0.05) and mast cell degranulation (72.50±8.37) against standard, disodium cromoglycate, (85.19 ± 4.30) (P<0.001)	118
<i>Chenopodium album</i>	the plant was extracted in ethanol and fractionated in ethyl acetate, chloroform, <i>n</i> -butanol and water.	intestinal smooth muscles of rabbit	The crude extract exhibited a dose-dependent increase in relaxation of smooth muscles, starting from 5 mg/ml and maximum effect was found at 20 mg/ml (92.86%). The ethyl acetate and chloroform fractions of <i>Chenopodium album</i> exhibited relaxation of the intestinal muscles (43.48 and 51.52%, respectively); whereas, <i>n</i> -butanol fraction of <i>Chenopodium album</i> produced strong relaxant effect (91.18%).	119-120
<i>Cichorium intybus</i>	a diester composed of (S,S)-tartaric acid and caffeic acid isolated from the plant	rat aorta strips	This compound did not affect contraction induced by a high concentration of potassium (60 mM K ⁺), while it inhibited NE-induced vasoconstriction in the presence of nicardipine. The inhibition of vasoconstriction is due to a decrease in calcium influx from the extracellular space, which enhanced by NE.	121-122
<i>Cistanche tubulosa</i>	echinacoside, a phenylethanoid glycoside isolated from <i>Cistanche tubulosa</i>	rat thoracic aortic rings	Echinacoside mediates the endothelium-dependent vasodilator action in rat thoracic aortic rings through nitric oxide (NO)-cGMP pathway.	123
	methanolic extract from the dried stems	rat aortic strips	It showed inhibitory effect on contractions induced by noradrenaline in isolated rat aortic strips. Kankanoside F, kankanose, echinacoside, acteoside, and cistanoside F, which isolated from the extract were responsible for the vasorelaxant activity.	124
<i>Clerodendrum inerme</i>	methanolic extract	rabbit jejunum and rat uterus	The extract produced the normal rhythmic contraction of rabbit jejunum, which reversed by prior addition of cyproheptadine. Methanolic extract also produced a stimulant activity on rat uterus which was blocked by cyproheptadin.	125-126
<i>Citrus aurantifolia</i>	aqueous extract	In vivo, rabbits and in vitro rat aortic strips	The extract possessed anti-hypertensive activity by cardiodepression and vasorelaxation. It evoked vaso-relaxant effects which totally abolished by removal of the endothelium layer or by a pretreatment with L-NAME	127-128
<i>Convolvulus arvensis</i>	ethanolic and aqueous extracts	rabbit aortic rings	It appeared that calcium-dependent K channels (BKCa) has a partial role in the relaxing effect of the ethanolic extract, but not aqueous extract. However, with the using	129-131

			of high K ⁺ Krebs, both extracts exhibited relaxant effect due to reducing the entry of calcium ions from outside. The adrenergic receptor $\alpha 1$ has a role but with different magnitude between the extracts, with high degree for aqueous extract, that reduced the maximum response (E_{max}) of aortic rings to phenylephrine, and this was similar to the effect of $\alpha 1$ -blocker (prazosin).	
<i>Cordia myxa</i>	fruit mucilage at different stages of maturity	In vivo, rabbit	It caused hypotensive effect and respiratory stimulant effect. The hypotensive effect was due to activation of parasympathetic ganglia and dilatation of peripheral blood vessels, whereas the respiratory stimulant effect was due to activation of chemoreceptors in the aortic arch and carotid body.	132
	alcoholic extract	sheep trachea.	<i>Cordia myxa</i> extract inhibited contraction in both epithelium-intact and denuded sheep trachea rings induced by acetylcholine. The scale of relaxation with <i>Cordia myxa</i> extract was dose dependent and slightly more potent in epithelium denuded rings than epithelium-intact preparations. L-NAME (10 nM-100 uM) but not DNAME completely inhibited the relaxant effect in a concentration dependent manner. <i>Cordia myxa</i> extract - induced relaxation was inhibited by methylene blue (1 -100 uM), and verapamil (100 nM), and removal of extracellular Ca ²⁺ . In contrast, <i>Cordia myxa</i> extract - induced relaxation was potentiated by Nw-nitro-Larginine (L-NOARG) treatment.	133-134
<i>Crocus sativus</i>	hydro-ethanolic extract of stigma and safranal	on guinea pig tracheal chains and ovalbumin-sensitized guinea pigs	It caused relaxant, inhibitory effect on histamine (H1) and muscarinic receptors, and stimulatory effect on β -drenoceptor on guinea pig tracheal chains. The results showed a preventive effect of the extract and its constituent safranal on total and differential count of WBC in blood of sensitized guinea pigs.	135-136
	petals' aqueous extract	rat vas deferens and guinea-pig ileum	The isolated rat vas deferens and guinea-pig ileum evoked contractions were decreased by aqueous and ethanol extracts of <i>Crocus sativus</i> petals. The aqueous extract (560 mg/ml) significantly reduced the contractile responses of vas deferens to epinephrine (1 microM) without any change in contraction induced by KCl (300 mM).	137
<i>Datura metel</i>	leaf and root extracts	rat uterus and rectum smooth muscles	The leaf extract and scopolamine showed antispasmodic effects, whereas root extract and acetylcholine caused contraction of the isolated rat uterus and rectum whole muscle. The results indicated that the plant contained antispasmodic and spasmogenic constituents.	138
<i>Daucus carota</i>	a nitrogen containing tertiary base isolated from the seeds of <i>Daucus carota</i>	ileum, uterus, blood vessels and trachea of different species of animals	The tertiary base possessed papaverine like nonspecific smooth muscle relaxant and spasmolytic activity, but its activity was found to be about one-tenth of that of papaverine.	139-140
<i>Dodonaea viscosa</i>	compounds isolated from the chloroform-methanol (1:1) extract (sakuranetin	guinea-pig ileum	All the isolated compounds elicited a concentration-dependent inhibition of the spontaneous and electrically-induced contractions of guinea-pig ileum. Sakuranetin and the ent-labdane inhibited	141-142

	, 6-hydroxy kaempferyl 3,7-dimethyl ether, haustriolic acid, and ent-15, 16-epoxy-9 alpha H-labda-13(16)14-diene-3 beta, 8 alpha-diol)		ileum contractions evoked by acetylcholine, histamine, and barium chloride.	
<i>Dolichos lablab</i>	alcoholic fraction	In vivo, respiratory smooth muscles	Sixty seven percent inhibition of spasm in respiratory smooth muscles were observed of <i>Dolichos lablab</i> alcoholic fraction at 100 mg/kg body weight	143-144
<i>Erodium cicutarium</i>	several organic extracts	guinea pig ileum and rat uterus	Hexane extract, increased the tone of the guinea pig ileum preparation and reduced the strength of the contractions following field stimulation. All extracts had a spasmogenic action on isolated uterus preparation of the rat. The methanol extract produced regular monophasic contractions of the quiescent uterus, which ceased immediately when the tissue was washed.	145-148
<i>Ephedra species</i>	ephedrine	Tracheae of cats, dogs, rabbits, guinea-pigs, and rats. Clinical	The smooth muscle of the bronchial tree was relaxed by ephedrine. Compared with epinephrine, the action of ephedrine was slow in onset, complete an hour or more after administration. Ephedrine also prevented histamine-induced bronchoconstriction in patients with asthma.	149-151
<i>Equisetum arvense</i>	dicaffeoyl-meso-tartaric acid from <i>Equisetum arvense</i>	rat aorta strips	It showed slow relaxation activity against norepinephrine (NE)-induced contraction of rat aorta with/without endothelium. This compound did not affect contraction induced by a high concentration of potassium (60 mM K ⁺), while it inhibited NE-induced vasoconstriction in the presence of nicardipine.	152-153
	alcoholic extract	guinea-pig ileum	The extract antagonized the effect of acetylcholine on the isolated guinea-pig ileum preparation	154
<i>Fumaria parviflora</i>	aqueous-methanol extract	jejunum, ileum and tracheal preparations of rat, guinea-pig and rabbit	The aqueous-methanol extract predominately more potent against CCh than isotonic high K ⁺ solutions-induced contractions, similar to dicyclomine, suggesting the presence of anticholinergic and calcium channel blocking [CCB] activities, which were confirmed when the extract shifted the CCh and Ca ²⁺ concentration-response curves in rat ileum and trachea, towards right. Among intestinal preparations from various species, both anticholinergic and CCB effects of the aqueous-methanol extract were exhibited at lower concentrations in rat than the other species. In tracheal preparations, the extract was the most potent in its CCB effect in rabbit.	155-156
<i>Glycyrrhiza glabra</i>	the hydro-alcoholic extract	rat colon	The hydro-alcoholic extract of licorice had modifying effect on colon motility via synergist effect with beta adrenergic receptors and independent of the alpha adrenergic receptors.	157-158
	Isoliquiritigenin isolated from an aqueous extract of licorice	several isolated tissues	It was a potent relaxant, inhibited the contraction induced by various types of stimulants, such as CCh, KCl, and BaCl ₂ with IC ₅₀ values of 4.96±1.97 microM, 4.03±1.34 microM and 3.70±0.58 microM	159-160

	alcoholic extract of licorice rhizome	rat duodenum pieces	Alcoholic extract of licorice rhizome decreases bowel motility. The contraction force exerted on the isolated duodenum pieces by acetylcholine was remarkably reduced in the presence of licorice rhizome extract compared to that of the control group ($P < 0.05$). However, this response in the presence of atropine, propranolol and N-nitro-L-arginine methyl ester (L-NAME) was not changed significantly.	161-162
<i>Hibiscus sabdariffa</i>	aqueous extract	rabbit aortic strip, rat uterus, guinea-pig tracheal chain and rat diaphragm	inhibited the tone of various isolated muscle preparations (rabbit aortic strip, rhythmically contracting rat uterus, guinea-pig tracheal chain and rat diaphragm). Other muscles were stimulated (quiescent rat uterus and frog rectus abdominis).	163
	methanol extracts	In vivo in rats and in vitro, rat ileal strip	a significant ($p < 0.01$) dose dependent relaxant effect ($IC_{50} = 350 \mu M$) on rat ileal strip comparable to the effect shown by nifedipin and papaverine. The extract when administered ip., it also significantly ($p < 0.05-0.01$) reduced the intestinal transit (13-35%) in rats ($IC_{50} = 250 \mu M$)	164-165
	aqueous extract	rat bladder and uterus	extracts induced rat bladder and uterine contractility in a dose-dependent manner via a mechanism unrelated to local or remote autonomic receptors or calcium channels	166
	extract of dried and powdered calyces	rat thoracic aorta	The crude extract induced mainly endothelium-dependent relaxant effects via NOS activation	167
<i>Hyoscyamus niger</i>	The crude extract of <i>H. niger</i> seeds (Hn.Cr)	rabbit jejunum, guinea-pig trachea and ileum and rabbit urinary bladder tissues	It produced antispasmodic effect mediated through a combination of anticholinergic and Ca^{2+} antagonist mechanisms. The relaxant effects of the extract occurred at much lower concentrations in the trachea and bladder than intestinal.	168-169
<i>Hypericum triquetrifolium</i>	Methanol extract	rat isolated aortic rings	The maximal inhibition obtained by the extract for the phenylephrine contractions was $93.95 \pm 5.23\%$, while the maximal inhibition was found as $85.78 \pm 4.87\%$ for KCl contractions. However, extract inhibited both phenylephrine and KCl induced contractions in a concentration-dependent manner	170-171
<i>Juniperus oxycedrus</i>	methanol and dichloromethanol extracts of the leaves and stems	different isolated tissues of rats and guinea-pigs	Extracts inhibited the concentration curve response to histamine, serotonin and acetylcholine induced contractions.	172-173

II. CONCLUSION:

The current review discuss the stimulatory and inhibitory effects of medicinal plants on contractility of respiratory, urinary, gastrointestinal, vascular and reproductive system smooth muscle, with their possible mechanisms to encourage the usage of medicinal plants for therapeutic purposes as a result of effectiveness, availability and safety.

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